Evidence of Vacancy Formation During the Low Temperature Growth of Cu on Cu(001)

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Abstract No. bote3950
Beamline(s): **X3B2**

We have studied the low-temperature growth of Cu on Cu(001), using x-ray reflectivity. At T=110K, for coverages larger than 15ML, we observe that the specular reflectivity lineshape exhibits a pronounced asymmetry around the (002) Bragg reflection, as shown in **Figure 1**. Since x-ray scattering probes not only the surface morpholology but also the subsurface structure, we believe that the above-mentioned feature stems from structural differences between the deposited film and the underlying bulk crystal. More specifically, our data is well explain by a real-space model where, in addition to the surface roughness, it is assumed that the deposited film is slightly strained with respect to the bulk, due to vacancy formation. Similar experiments on Ag(001) and Ag(111) have shown that a high vacancy concentration (~ 2%) can be achieved during the homoepitaxial growth at T=100K. The vacancies, which extend throughout the thickness of the deposited film, are likely to have a significant effect on the morphology of the evolving surface. We plan to address this issue as the next step of our investigation.

Support is acknowledged from the NSF, under contract DMR-9623827 and MISCON under DOE grant DE-FG02-90ER45427. The SUNY X3 beam line is supported by the DOE, under contract DE-FG02-86ER45231 and the NSLS is supported by the DOE, Division of Material Sciences and Division of Chemical Sciences

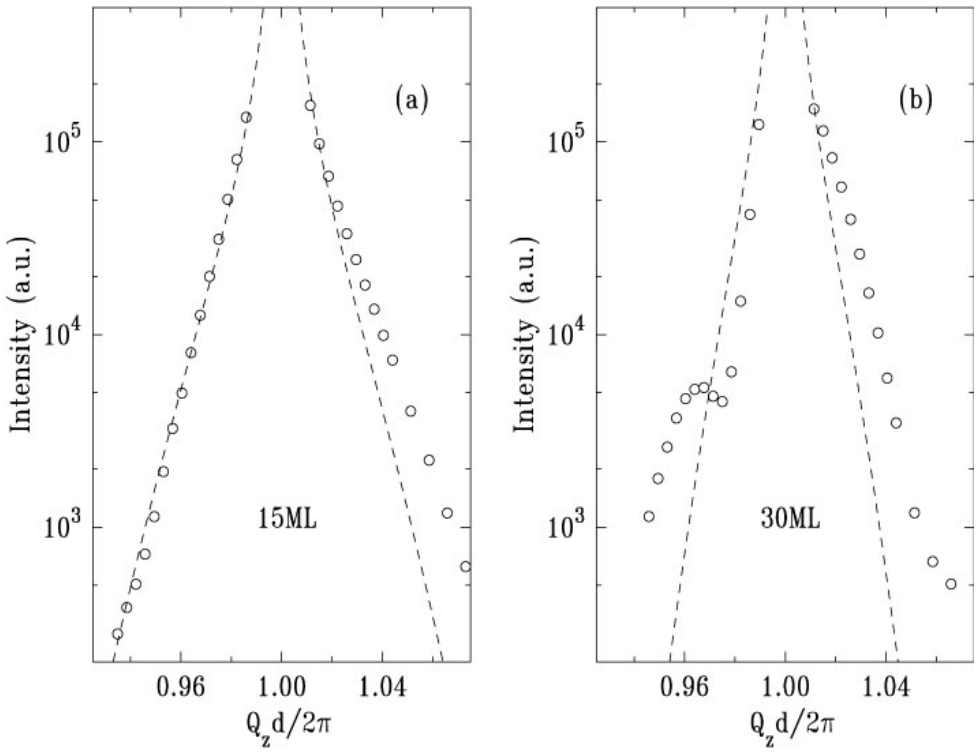

Figure 1. The specular reflectivity from Cu(001), measured at 110K for coverages of (a) 15ML and (b) 30ML (open symbols), exhibits a pronounced asymmetry around the (002) Bragg reflection (Q_z=1). This feature implies that there are structural differences between the deposited film and the underlying bulk crystal. The dashed lines, which represent the reflectivity calculated according to a real-space model that accounts only for the roughness of the surface, significantly deviate from the data.